# Using Early Childhood Booster Doses to Maintain the Elimination of Neonatal Tetanus

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BASICS

**BASICS**

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**Abstract**

Originally presented at WHO's Neonatal Tetanus Elimination Technical Consultation in Geneva, in April 1997, this discussion paper proposes practical solutions for long-term control of neonatal tetanus (NNT). This preventable disease continues to kill approximately 500,000 newborns each year. There is no single global blueprint for its control. Different strategies need to be used and combined over time to control the disease at affordable cost, depending on local circumstances.

Three key elements are included in this paper: (1) a discussion of the evolution of NNT control strategies and the role of early childhood boosters; (2) figures and graphs that illustrate why school children should be vaccinated in the early grades; and (3) recommendations for practical ways to introduce preschool and school-age tetanus boosters, including how to store and transport the vaccine, when and where to introduce vaccines, how to select the correct vaccine and immunization schedule, and how to market these immunizations to the public.

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# Acronyms

| | |
|---|---|
| AFR | African Region (of the World Health Organization) |
| ANC | antenatal care |
| BASICS | Basic Support for Institutionalizing Child Survival |
| DT | vaccine for diphtheria and tetanus (pediatric formulation) |
| DPT | vaccine for diphtheria, pertussis, and tetanus |
| EPI | Expanded Program on Immunization |
| FAWE | Forum of African Women Educationalists |
| MOH | Ministry of Health |
| NGO | nongovernmental organization |
| NID | National Immunization Day |
| NNT | neonatal tetanus |
| OPV | oral polio vaccine |
| PAHO | Pan American Health Organization |
| Td | vaccine for diphtheria and tetanus (formulation for older children and for adults) |
| TT | tetanus toxoid |
| UNESCO | United Nations Education, Scientific and Cultural Organization |
| UNICEF | United Nations Children's Fund |
| USAID | U.S. Agency for International Development |
| WHO | World Health Organization |
| WPRO | Western Pacific Regional Office (of the World Health Organization) |

# Executive Summary

As part of an ongoing effort to control neonatal tetanus (NNT), questions must be answered about why and how to introduce school-age boosters. This paper contains three sections, which include a review of the progress that has been made in controlling NNT and recommendations for maintaining the elimination of NNT. The first section explains the evolution of NNT control strategies and the role of early childhood boosters. The second section examines school enrollment data and discusses the case for adding school-age boosters as an additional strategy to control NNT. The third section, to stimulate discussion and clarify issues, reviews the practical implication of introducing preschool and school-age booster doses. Following the Executive Summary, specific recommendations are presented for the Ministries of Health (MOHs), World Health Organization (WHO), and the United Nations Children's Fund (UNICEF) about how to introduce school-age boosters. Most of the information and suggestions in this discussion paper were presented by the author in April 1997, in Geneva, at the Neonatal Tetanus Elimination Technical Consultation.

## Planning Strategies

For countries that have an established health system and the capability to immunize their citizens, the priority now is to sustain the gains in immunization coverage. To control NNT, countries must select the most affordable, efficient, and effective strategies for tetanus prevention, including the use of early childhood and school-age booster doses. A variety of short-, medium-, and long-term strategies needs to be considered.

The selection of NNT control strategies and the identification of the target groups to immunize must be balanced against providing immediate protection to women at high risk for delivering a baby with NNT and the need to increase immunity in the community. Two questions must be answered when strategies and target groups are selected: (1) What is the expected result of interventions for different target groups? and (2) How easy is it to identify and reach these groups? Program managers should be opportunistic and immunize target groups where they are easily found. In some cases, this may mean sacrificing the immediate impact on reducing NNT incidence in favor of longer-term protection for the population and future gains in NNT reduction.

## Sustaining Control

Now that the 1995 target year for achieving global elimination of NNT as a significant public health problem has come and gone, it is time to put NNT control onto a longer-term footing because its elimination must be permanently sustained. There is no single global blueprint and there is no single correct strategy in all situations. Different strategies need to be used and combined, over time, to control the disease at affordable cost, depending on local circumstances. The immunization strategies and most appropriate target groups must be defined for each country, based on the examination of local data and consideration of local factors.

Along with mass tetanus immunization campaigns in high-risk areas, which are intended to immunize unprotected women quickly with two doses of tetanus toxoid (TT), longer-term strategies are needed, not only to maintain waning protection against tetanus throughout the childbearing years but also to protect adolescent females whose need for timely protection cannot be met by infrequent “follow-up” campaigns. Fortunately, there is a wide window of opportunity, lasting many years, during which it is possible to immunize females to prevent NNT.

When plans are made to administer booster doses against tetanus, the plans should include the requirements to control pertussis and diphtheria. Compromises may be needed to schedule booster doses for all the diseases. Tetanus protection can be extended with additional doses in a child’s second year of life and at school entry. A fourth dose of diphtheria, pertussis, and tetanus vaccine (DPT) in the second year of life is being used by 50 to 81 percent of countries in each WHO region, except the Africa Region (AFR), where only 27 percent of the countries offer it. DPT4 is the preferred vaccine for early childhood boosters. Children receive a lower level of protection against pertussis if they receive only three doses of DPT at monthly intervals.

To sustain the progress made by immunizing both childbearing-age women in high-risk areas and infants, many countries should consider adopting a supplementary population-based approach to immunizations, such as school-age boosters. School-based immunizations are an investment in today’s children that will produce future benefits when these children become parents. In countries with a high female primary school enrollment, school immunizations may be a cost-effective investment for tetanus prevention, especially if they are part of an integrated primary health care strategy that includes health education and the simultaneous administration of anthelmintics, screening and treatment for trachoma, treatment for lymphatic filariasis, group A meningococcal meningitis immunization, typhoid immunization, and others.

## Taking Advantage of High Enrollment

During the past 20 years, the primary school enrollment of females has increased dramatically, even in many countries where NNT is still a serious problem and infant DPT coverage rates remain low. The immunization program can take advantage of this high enrollment. In the first grade of primary school, enrollment ratios are above 90 percent in all regions except sub-Saharan Africa, where they are approximately 70 percent. It is appropriate to focus on enrollment ratios in the lowest grades of primary school because females who drop out of school are more likely, when they are adults, to deliver a baby with tetanus than are females with more years of schooling.

Early in primary school, when female enrollment is high and before girls begin to drop out of school, diphtheria-tetanus pediatric formulation (DT) or tetanus-diphtheria formulation for older children and for adults (Td) immunizations should be introduced, using a variety of schedules. The immunizations produce long-lasting immunity from each successive dose of tetanus toxoid due to an anamnestic response to earlier doses. School-based immunizations, whether as priming or booster doses, reduce the remaining doses needed for complete protection when women, as adults, are harder to locate. Depending on the number of doses a child receives in infancy and early childhood, additional school-age boosters can provide protection against NNT for first births, when females (frequently teenagers) are often poorly protected against tetanus.

When female enrollment is high, the systematic use of DT and Td at school is similar to institutionalizing a mass campaign in slow motion. A narrow age group is routinely immunized at the same time, and the immunizations for this age group are repeated year after year. In areas where female school enrollment is still modest, but is higher than the infant immunization coverage rate was five years earlier, school-based immunization becomes a "catch-up" campaign. In this case, the immunizations can close the immunity gap that developed with recent increases in infant immunization coverage. In many settings, both female and male school-age children should be immunized to prevent rumors that the vaccines are related to fertility control.

## Using Data to Get Started

Within countries, national-level data conceal disparities by province, district, gender, and grade. It is important to solicit data on a few indicators, such as female school enrollment by grade, in districts considered to be at the highest risk for NNT. Attachment A, a data collection instrument, can be used for this purpose. Attachment B, when completed, can be used to make decisions at the country and district level about where and when to add school-age booster immunizations to fight NNT. Attachment B also asks for input and opinion from the field on the type of data that should be collected and that could be easily collected.

## Encouraging Discussion

To stimulate discussions and clarify the issues about booster doses, the final section reviews practical implications for introducing preschool and school-age booster doses. The introduction of booster doses is discussed in terms of nomenclature; phasing in the boosters in districts within countries according to "rules of thumb"; organization; choice of vaccine; immunization schedules; combined and multi-antigen interventions; cold chain, vaccine logistics, and injection safety; monitoring; serology; timing of school visits; procurement; screening; and marketing/information, education, and communication. Managers will need a manual to guide them in making locally appropriate decisions.

# Recommendations

During the presentation of this paper at the Neonatal Tetanus Elimination Technical Consultation at WHO in Geneva in April 1997, the author was requested to summarize the principal recommendations, which appear below:

1. With guidance from WHO, MOHs are encouraged to do a one-time review of existing selected educational data in each district where NNT is suspected to be a significant public health problem. Such data can be used to decide if, where, and when female and male school-age children should be targeted to receive one or more tetanus boosters as a supplementary longer-term NNT elimination strategy.

2. WHO should review the practical field experience and results achieved in implementing preschool and school-age boosters in a variety of settings. They should issue guidelines and criteria to countries on when, where, and how to conduct preschool and school-based immunization programs.

3. When enrollment of girls in primary school is higher than 70 percent and resources are available, MOHs should introduce DT or Td (using a variety of possible schedules) in early grades of primary school to both girls and boys to prolong the period of protection against tetanus.

4. MOHs should introduce a “maintenance” school-age booster schedule, in eligible districts, consisting of DT1 or Td1 in grade 1, DT2 or Td2 in grade 2 (at least 12 months after DT/Td 1), and Td3 in grade 3 (at least 12 months after DT/Td2).

5. In countries with high female enrollment in higher grades of primary or secondary school, MOHs should introduce a “maintenance” booster schedule, in eligible districts, consisting of DT1 or Td1 in grade 1, DT2 or Td2 in grade 2 (at least 12 months after DT/Td1), and Td3 in the highest primary or secondary grade where the number of female students exceeds 80 percent of the number of female students in grade 2 (at least 12 months after DT/Td2).

6. The MOHs and technical partner agencies should review positive and negative experiences with school-retained versus parent-held tetanus protection cards to determine the practicality and desirability of their use in recording and integrating past immunization records for the purpose of future screening.

A more complete list of detailed recommendations from the paper follows:

- MOHs and their partners should adopt a flexible approach to the phased-in introduction of DPT4, on a district-by-district basis, without endangering efforts to attain high DPT3 coverage in infants. MOHs should not be required to meet a predetermined level of DPT3 coverage at the national level or in every district before DPT4 can be introduced in specific districts. The need for protection and risk from disease are not uniform within a country because, frequently, immunization programs have changed the pattern of disease.

- MOHs from each country working with WHO and UNICEF should decide whether or not to include DPT4 in the primary immunization schedule of the Expanded Program on Immunization (EPI). Each country should review district data before it makes any decisions.

- To advise countries on when, where, and how to conduct preschool and school-based immunization programs, WHO should summarize the practical field experience in implementing school-age boosters in a variety of countries.

- WHO should inventory countries and areas of countries with school-based immunization programs and describe their experience, including the vaccines used, timing and number of school visits, target population (girls, boys, ages), combination of interventions, frequency of visits, coverage achieved, organizational responsibility (MOH, Ministry of Education, and school health division), and practical implementation issues (cold chain, vaccine logistics, injection safety, and others).

- Because national-level data may conceal potentially important subnational disparities, WHO should solicit input from a variety of field settings about the type of data that could be easily collected and used to make country- and district-level decisions about where and when to add school-age booster immunization. Based on the information, WHO should develop a standard data collection instrument to solicit data on a few indicators, such as female school enrollment by grade, in the districts considered to be at the highest risk for NNT.

- MOHs in many countries should take advantage of high female enrollment in primary schools—a "captive" population—to increase and extend protection against tetanus and diphtheria. Without compromising the immunization of infants and women of childbearing age, MOHs should use limited resources to start school-age booster immunization in areas known or presumed to be at high risk for NNT.

- MOHs should review district-level data on female enrollment in primary school (as opposed to current or historical levels of DPT3 or DPT4 coverage). They could use the data to plan when and where to phase in school-age booster immunization with DT/Td for *girls and boys*, after they confirm that sufficient financial, logistical, and human resources exist, and that infant immunizations will not be jeopardized.

- MOHs should use DT or Td for the school-age boosters given to children 5 and 6 years of age.

- MOHs should use Td (instead of TT) for all booster doses in adults and children age 7 years and older.

- To determine when to phase out DT and replace it with Td for school-age immunization, MOHs should monitor the rate of serious booster reactions because DT is more immunogenic and reactogenic than Td in previously immunized children.

# MOHs should use the following criteria to select the districts where school-age boosters for girls and boys will be introduced: (1) when female enrollment ratios in primary schools in the district, particularly in the early grades, exceed 70 percent; or (2) when current female enrollment ratios in primary schools in the district, particularly in the early grades, exceed current infant DPT3 coverage rates.

# When a school-age booster schedule is introduced in eligible districts for the first time, MOHs should consider immunizing the backlog of girls and boys with a one-time catch-up for some or all of the primary grades, if resources are available.

# MOHs should introduce the following maintenance booster schedule in eligible districts: DT1 in grade 1, DT2 in grade 2 (at least 12 months after DT1), and Td3 in grade 3 (at least 12 months after DT2).

# In countries with mature educational systems, MOHs should introduce the following maintenance booster schedule in eligible districts: DT1 in grade 1, DT2 in grade 2 (at least 12 months after DT1), and Td3 in the highest primary or secondary grade in which the number of female students exceeds 80 percent of the number of female students in grade 2 (at least 12 months after DT2).

# When school-based immunization is introduced, the MOHs should offer the same booster immunization schedule to school-age children who do not attend school.

# In countries where the female secondary school enrollment ratios exceed 50 percent (such as Egypt, Iran, Sri Lanka, and China), MOHs should consider temporarily adding one Td booster during secondary school. Eventually, when most school children have received three school boosters before they enter secondary school, this dose can be discontinued.

# Countries emerging from years of civil unrest, such as Eritrea and Cambodia, may have a better developed primary education system than health system. Without diverting resources from the priority task of protecting infants with the primary series, MOHs should consider providing catch-up (priming), as well as maintenance (booster), DT/Td doses to young girls and boys of school age.

# To guide the modification of adult immunization schedules, target groups, and delivery strategies, the MOHs should periodically conduct carefully designed studies of pubescent girls using population-based serological testing for tetanus and diphtheria immunity.

# When school-age boosters are introduced, the MOHs should (1) calculate the vaccine and syringe/needle/sterilizer requirements and replacement; (2) determine the optimal scheduling between districts and schools within districts; (3) assess the capacity, at each level of the existing cold chain, to store and transport greatly increased volumes of vaccine; and (4) determine how often the vaccine is resupplied.

# WHO and UNICEF should agree on the inclusion of DT and Td booster doses for developing countries; otherwise, UNICEF, on its own, may not be willing to authorize procurement.

- WHO and UNICEF should determine the availability and price of DT and Td in vials larger than the current size.

- When they revise infant immunization cards, MOHs should add a space to record school-age booster doses.

- To determine if it is practical and desirable to use tetanus protection cards for recording and integrating past immunization records for future screening, MOHs and their technical partner agencies should review positive and negative experiences with school-retained versus parent-retained cards.

- MOHs should decide if additional public health interventions (e.g., trachoma screening and treatment, lymphatic filariasis dosing, deworming, health education, group A meningococcal meningitis immunization, typhoid immunization, and others) should be included during the annual immunization visit to primary schools in the eligible districts.

- After MOHs evaluate the logistics burden, they should consider combining school-based toxoid administration with other major immunization campaigns for the same age group. For example, they could add mass measles and rubella immunization within schools or routine oral polio vaccine (OPV) to children in the first grade in non-endemic areas that have discontinued their polio National Immunization Days (NIDs) or typhoid immunization in areas with high typhoid mortality or multiple antibiotic resistance.

- To avoid confusion when booster doses are introduced, MOHs should provide information, education, and communication to health workers and parents. MOHs should ask civic leaders and religious authorities to participate when school-based campaigns are planned.

- To prevent rumors that tetanus boosters are connected to fertility control, MOHs should immunize both females and males. They should stress that boosters provide protection against tetanus caused by injuries during sports, planting, and other activities. Because all children may not be enrolled in school, MOHs must ensure that the community understands the need for boosters.

# Evolution of NNT Control Strategies and the Role of Early Childhood Booster Doses

## Introduction

During its first two decades, the Expanded Program on Immunization (EPI) stressed that a system was needed to ensure that each cohort of infants received timely immunizations. Their primary goal was to reduce the public health burden of vaccine-preventable diseases by immunizing 80 percent of infants every year. Now that an immunization delivery system and capability exist, and there are sustained high infant coverage levels in many countries, some immunization programs are using routine booster doses to extend the protection from vaccines and increase the control of target diseases. To continue the gains in immunization coverage—a top priority—program managers must select the most affordable and effective strategies, including the use of booster doses.

The role of boosters must be discussed within the broader context of what is required to achieve and sustain the elimination of neonatal tetanus (NNT). Effective strategies for controlling NNT have evolved during the past two decades; they include a variety of short-, medium-, and long-term approaches.

## NNT Control Strategies

The continuous priming of infants with diphtheria, pertussis, and tetanus (DPT) remains an undisputed part of NNT control programs even though this is the slowest strategy to prevent NNT. See table 1 for a comparison of the immediate impact of NNT in individuals versus the expected programmatic efficacy of interventions for different target groups.

**Table 1. Comparison of Target Groups and Interventions on Neonatal Tetanus (NNT) Control**

| Vaccine | Target Group for Intervention | Immediacy of Impact on NNT in Individuals | Programmatic Efficacy[1] |
|---|---|---|---|
| DPT | Infants | Slow | High |
| DT/Td | School children | Slow | High |
| TT/Td | Pregnant women | Fast | Varies |
| TT/Td | Age 15–44 (continuous) | Intermediate | Low |
| TT/Td | Age 15–44 (campaigns) | Intermediate | High |

[1] A product of the technical efficacy of and coverage with the intervention.

Early strategies to control NNT depended on the timely identification and immunization of women during pregnancy. In many areas, serious operational and cultural obstacles impeded their implementation, particularly if antenatal care (ANC) services were undeveloped or underused. The use of ANC at fixed facilities was low and remains low or, in some areas, occurs late in pregnancy. Many countries adopted periodic outreach or mobile strategies, but trying to identify only pregnant women, at a specific time, was like trying to hit a moving target when the marksman, or health worker, was also on the move (Steinglass, Brenzel, Percy 1993). Documented obstacles include the cultural reluctance to acknowledge pregnancy, resistance to vaccination during pregnancy, and failure to refer women for vaccination early enough in the pregnancy (Rahman et al. 1982).

It seemed logical to focus on pregnant women as a target group for tetanus toxoid (TT)—this group was at immediate risk—but the strategy was operationally impractical for many developing countries. The newborn is protected if the pregnant woman receives the correct number of properly spaced doses. But, unless ANC services are well developed and appropriately used, a broad target strategy focusing exclusively on pregnant women can be expected to have low programmatic efficacy (a product of technical efficacy of and coverage with the intervention), and it will not achieve a rapid reduction in NNT.

Therefore, population-based strategies were considered necessary, especially because susceptibility to tetanus is general and the causative agent is ubiquitous. The World Health Organization (WHO) pioneered a strategy of continuous immunization, with a total of five doses of TT for women of childbearing age, including pregnant women. This does not protect individual newborns as rapidly as immunizing women who are already pregnant, but, eventually, it would protect the susceptible population. However, because women should be screened and immunized or referred during any health facility visit, it has been difficult to implement this strategy without a strong commitment by health services, additional resources, and durable medical records that show if immunization is required. In many areas, this intervention has not been successful.

Whether the target group is pregnant women or all women of childbearing age, it is difficult to determine if an individual has been immunized and if additional doses of TT are needed to protect future births from NNT. Good immunization records are important, but their introduction require resources and commitment.

## Increasing Immunization Opportunities

Missed opportunities for immunization, which are widely documented, must be reduced. In Kilifi District, Kenya, for example, an NNT mortality survey showed that 12 percent of mothers who attended antenatal clinics at least twice during the index pregnancy had not received TT during their last two pregnancies; those mothers accounted for four of the eight cases of NNT found during the survey (Bjerregaard et al. 1993). The level of missed opportunities could have been reduced if, at every antenatal contact, durable home-based tetanus protection cards for recording all doses of TT had been used and the screening, referral, and immunization had been strengthened.

In other Kenyan districts, where antenatal clinics were not so developed or used as in Kilifi, results from the survey indicated that every contact any woman of childbearing age had with the health services was an opportunity for her to be screened and immunized. This, however, is not easily implemented.

### Identifying High-Risk Areas

Based on surveillance data from the Americas collected by the Pan American Health Organization (PAHO) that suggest a focal distribution of NNT, many countries have tried to identify geographic areas with a higher risk. In identified areas, all women of childbearing age, regardless of previous immunization history, were targeted for two rounds of TT by means of mass campaigns.

Despite the intermediate immediacy on NNT reduction among those reached, mass immunization of all women of childbearing age in high-risk areas is attractive because of its higher programmatic efficacy (see table 1). This strategy offers a relatively quick return on investment by reducing NNT incidence. To sustain the decline, however, campaigns must be repeated periodically as new cohorts of underimmunized women enter their childbearing years and as immunity wanes among the vaccinated women. There must be vigorous surveillance in "silent" areas and a constant effort made to detect new high-risk areas. Further experience with this strategy may be needed to determine the extent to which it is NNT incidence or effective surveillance which is primarily focal. Experience is needed to determine which indicators can best identify high-risk areas.

## Continuum of Individual Risk

Another way to look at the challenge of controlling NNT is to use a continuum of risk for NNT to classify possible target groups for intervention. When control strategies are designed and implemented, the ease of locating and identifying the target groups can then be considered (see table 2).

**Table 2. Continuum of Risk for Neonatal Tetanus (NNT) by Target Group, Ease of Location, and Programmatic Efficacy**

| Target Group for NNT (Highest to Lowest Risk) | Ease of Locating Target Group | Programmatic Efficacy[1] |
|---|---|---|
| Women with previous birth with NNT | Hard | Low |
| Individual women at high personal risk based on known social factors | Hard | Low |
| All women living in areas of elevated risk based on socio-epidemiological factors | Moderate | Moderate |
| All pregnant women | Varies (antenatal care not universal) | Varies |
| School girls | Easy | High (if primary school enrollment is high) |
| Female infants | Moderate | High |

**Problem:** Individuals with the highest risk are not easily located.

**Solution:** Use broad population-based measures, guided, when possible, by sociodemographic, surveillance, and serological data. Be opportunistic and immunize population groups where they are easily found.

[1] A product of the technical efficacy of and coverage with the intervention.

A woman who has given birth to a baby who died from NNT is at the highest risk of delivering another baby with NNT. These women must be immunized any time they present, but it is not practical to base an immunization strategy exclusively on locating them. The second highest risk group has social factors that have been identified (home delivery, presence of animals near home, low socioeconomic conditions, and others), but it is not easy to define or locate these individual women with sufficient specificity to guide implementation of the program. Targeting the first two risk groups has low programmatic efficacy.

The third and fourth target groups—all women in areas of elevated risk, based on socio-epidemiological factors, and all pregnant women—are at lower immediate risk but are easier to locate, depending on the organization of health services in the country.

The fifth and final target groups, school girls and female infants, have the lowest immediate risk; these groups, however, will eventually give birth to all future cases of NNT. Programmatic efficacy for reaching the target groups is high because they can be easily identified and immunized. When they are older, they will need additional doses of tetanus formulation for older children and for adults (Td).

In summary, the problem remains that individuals at highest risk cannot be easily identified or reached by the health system. The solution may be to adopt broader population-based measures that rely as much as possible on surveillance data, including socio-epidemiological and serological data. Program managers must be opportunistic and immunize target groups where they are easily found. In some cases, to provide the population with long-term protection and achieve future benefits in NNT reduction, program managers may be forced to sacrifice the immediate protection of high-risk groups.

## Continuing the Search for NNT Control Strategies after 1995

It is time to look at long-term NNT control now that the 1995 target year for the global elimination of NNT as a public health problem has come and gone. Unlike the elimination and eradication of viral diseases (e.g., smallpox, polio, and measles), countries can never stop vaccinating and revaccinating against tetanus because the infective tetanus agent persists in the environment and cannot be eradicated. The elimination of NNT needs to be sustained forever by active immunization or until hygienic obstetric care is universal.

The communicable disease models for smallpox and polio eradication and for measles elimination do not apply to NNT elimination. To eliminate viral diseases, a high level of energy and resources must be maintained, combined with quick synchronized bursts of activity during a few years, to reach the “finish line.” With NNT, however, there is no finish line. Mass campaigns against tetanus must be supplemented with either periodic follow-up campaigns or other long-term solutions, depending on the development of a country’s health services.

Fortunately, there are many immunization strategies aimed at different target groups that can be used to control tetanus. There is no single global blueprint and there is no single correct strategy in all situations. Different strategies need to be utilized and combined, over time, to control the disease at affordable cost, based on local circumstances. The immunization strategies and the most appropriate target groups must be defined in each country, depending on the examination of local data and consideration of many factors (Steinglass, Brenzel, and Percy 1993), including the following:

- Level of tetanus incidence
- Level of resources available
- Organization and utilization of health services
- Contact channels, including schools, bride registration, traditional birth attendants, ANC, and others
- Immediacy of desired effect
- Cost-effectiveness
- Opportunity costs of competing health interventions and strategies
- Marginal cost of different control strategies
- Operational and behavioral considerations

In the continuing post-1995 effort to achieve and sustain NNT elimination as a public health problem, routine infant immunization with three doses of DPT remains as the first pillar upon which NNT control rests, and it must be vigorously supported to ensure continued priming of future cohorts. ANC visits will be important in some countries that have well-utilized services. In other areas, the continuous routine immunization with five doses of TT for adult women is more suitable. In known or presumed high-risk areas, mass catch-up campaigns will increasingly be favored to rapidly reduce the backlog of unimmunized adult women. The frequency of follow-up campaigns to maintain high levels of protective immunity in the population will need to be determined.

Along with mass tetanus immunization campaigns, which are intended to immunize unprotected women quickly with two doses of TT, longer-term strategies are needed, not only to maintain waning protection against tetanus throughout the childbearing years but also to protect adolescent females entering the period of risk for the first time. Their need for timely protection cannot be met by infrequent follow-up campaigns.

Fortunately, there is a wide window of opportunity for immunizing females to prevent NNT. This differs from measles, for example, where there is a brief period of time between susceptibility and exposure to the disease. With the wide choice of possible vaccines, target groups, and intervention strategies, the role of early childhood booster doses should be closely examined.

## Early Childhood Booster Doses

The active immunization of successive cohorts of the entire population is required first to control tetanus and then, because of continuous environmental risks of contamination, to sustain its elimination as a public health problem. Ideally, women entering their childbearing years should already be protected with a course of five correctly spaced doses of tetanus toxoid, including DPT, diphtheria/tetanus (DT), Td, and/or TT. When women receive tetanus protection early in life, cases of non-neonatal tetanus (non-NNT) are also reduced. This is important in developing countries because, after the critical neonatal period, children have the highest age-specific incidence of tetanus (Steinglass, Brenzel, and Percy 1993).

In Kilifi District, Kenya, despite high antenatal care coverage and a strategy that targeted pregnant women to receive TT, young women during their first pregnancy were significantly less well protected with TT than were multiparous mothers (Bjerregaard et al. 1993). Immunization strategies, including the use of early childhood booster doses, should ensure that early TT coverage is increased so that fertile nulliparous women entering their childbearing years are fully protected.

Many factors influence the number and frequency of boosters—

- Patterns of disease
- Maturity of the immunization program
- Health services infrastructure
- Costs and resource availability
- Opportunity costs

Many countries already include a fourth dose of DPT in their immunization schedule, usually in the second year of life or occasionally when the child starts school. Some countries that offer a fourth dose in the second year of life also offer a fifth dose at the time of or before school entry. See table 3 for primary and booster DPT immunization schedules in countries, by WHO region.

**Table 3. Immunization Schedules for DPT Vaccines Used in the Countries of Six WHO Regions**

| Region | Number of Countries | Number (%) of Countries Using Pertussis Vaccine in Schedule | | |
|---|---|---|---|---|
| | | Three primary doses only | Three primary doses plus one booster | Three primary doses plus two boosters |
| African | 48 | 35 (73) | 11 (23) | 2 (4) |
| American | 40[1] | 9 (23) | 11 (28) | 20 (50) |
| Eastern Mediterranean | 23 | 8 (35) | 9 (39) | 6 (26) |
| European | 46[2] | 8 (17) | 32 (68) | 6 (13) |
| South-East Asia | 10 | 5 (50) | 4 (40) | 1 (10) |
| Western Pacific | 32[3] | 16 (50) | 10 (31) | 6 (19) |
| **Total** | **199** | **81 (41)** | **77 (39)** | **41 (21)** |

[1] Haiti: Schedule unknown.
[2] Sweden does not use pertussis vaccine. Denmark uses monovalent pertussis vaccine.
[3] Cook Islands, Nauru, New Caledonia: Schedule unknown.

Source: Galazka 1996.

The need for booster doses against tetanus should not be considered in isolation from the requirements for pertussis and diphtheria control. To arrive at a schedule of booster doses appropriate for all the diseases, compromises may be needed. It is necessary to review the rationale and other considerations related to the choice of vaccine and the target ages.

### Tetanus boosters—

The expected duration of immunity against tetanus is five years after three correctly spaced priming doses of DPT. Protection can be extended for at least 15 years if additional doses are administered in the second year of life and at school entry (Global Program for Vaccines and Immunization 1995).

### Pertussis boosters—

- Booster doses raise antibody levels, maintain pertussis immunity into late childhood, and decrease transmission from school-aged children to younger siblings. The duration of immunity following immunization is not known.

- In countries with a low incidence of pertussis, due to long-lasting and successful immunization programs, a booster dose must be given one year after the primary series is completed. This extra protection is needed because circulation of the causative agents of pertussis and diphtheria is diminished, which reduces the opportunity to acquire immunity or to reinforce natural immunity (Galazka 1992).

- A fourth dose of DPT in the second year of life is used by 50 to 81 percent of all countries in each WHO region, except in the African Region (AFR), where only 27 percent of countries offer it (see table 3).

- Although the need for DPT5 is unclear, as some countries controlled the disease without it, a fifth dose of DPT before or at the time of school entry is offered by 4–50 percent of countries by WHO region (see table 3).

### Diphtheria booster—

- The duration of immunity against diphtheria is influenced by an individual's exposure to the organism. In developing countries, the persistence of immunity is not known.

- Before the vaccine era, diphtheria was a disease of young children. However, as immunization coverage of children increases, immunity gaps may appear in older age groups who were never immunized or who were immunized but were not naturally or artificially boosted. As diphtheria appears in older age groups in developing countries, booster doses may be needed (Global Program for Vaccines and Immunization 1995).

WHO recommends the following booster dose policies (Global Program for Vaccines and Immunization 1995):

> In all countries, and particularly where pertussis is still an endemic disease and poses a serious health problem in infants and young children, the priority should be to reach at least 90 percent coverage with a primary series of three doses of DPT vaccine in infants in all districts.
>
> In countries where pertussis incidence has been considerably reduced by successful immunization programs, a booster dose administered approximately one year after the primary series (at the middle

or the end of the second year of life) is warranted. A booster dose of DPT will also help to maintain immunity against diphtheria and will form part of the long-term strategy for neonatal tetanus control.

The need for additional booster doses of DPT or DT and their efficacy should be assessed by individual national programs.

In conclusion, a fourth dose of DPT, instead of DT, should be given for early childhood boosters because the primary series of three doses provides a lower level of protection against pertussis. To provide timely immunity against pertussis, which is more dangerous early in life, DPT4 should be given in the second year of life, approximately one year after DPT3 (from 15–23 months of age). The growing preschool attendance in some developing countries makes it increasingly important to provide an early booster dose against pertussis. The addition of an immunization contact in the second year of life provides another opportunity to ensure that children are fully immunized with all of their primary series vaccines.

# The Case for School-Age Boosters as an Additional NNT Control Strategy

## Introduction

Decision makers and donors face chronic deficiencies in resources. Consequently, both groups are attracted by strategies that show quick returns on investments because early successes have a potential to mobilize even more resources. However, immunity against tetanus must be maintained in individuals and populations throughout a long period of risk either by repeat mass campaigns or by routine delivery strategies. To sustain the momentum begun with the immunization of childbearing–age women in high-risk areas and to take advantage of gains made in infant immunization, the adoption of other population-based approaches, such as school-age booster immunization, should be considered as a supplementary strategy. School-based immunization is an affordable investment in today's children to realize future benefits when they become parents.

## Giving DT/Td in Early Grades

One long-term approach to reduce the incidence of NNT and sustain its elimination as a public health problem, including areas of high risk, is to routinely give children DT or Td (using a variety of possible schedules) in the early grades of primary school when the female school enrollment is high. This approach capitalizes on the long duration of immunity from each successive dose of tetanus toxoid and the anamnestic response to doses received long ago. School-based immunizations, whether priming or booster doses, reduce the number of doses required for complete protection, an important consideration when female students, after they become adults, are harder to reach. Depending on the number of doses received in infancy and early childhood, additional school-age boosters can provide protection against NNT for first births, which are typically more poorly protected than subsequent births and frequently occur during the teenage years.

In areas with high female school enrollment, using DT and Td at school is like institutionalizing a mass campaign in slow motion. A narrow age group is routinely immunized all at once, year after year. In areas with modest female school enrollment, but with enrollment higher than the infant immunization coverage rate was five years earlier, school-based immunization becomes a catch-up campaign. School-based immunization can close the immunity gap that developed because of the recent increases in infant coverage. To prevent rumors that the immunizations are related to fertility control, it may be necessary in some settings to immunize both female and male school-age children.

Immunizing school children, however, either with a primary or booster series of DT and Td, has been an underused and rarely studied strategy. Little empirical data are available that weigh the potential costs against the benefits of school immunization programs in developing countries, with the exception of a simulation exercise that evaluated the costs and benefits of school immunization against tetanus (Kessel 1984).

The Kessel model predicts that school immunization is the most cost-effective strategy for reducing NNT deaths, compared with a preschool program, antenatal clinic, and outreach immunization of pregnant women. The Kessel model assumes universal access to education. Clearly, the model does not apply in a developing country where female school attendance is low and attrition from grade to grade is a problem.

In countries with a high enrollment of female primary school children, immunizations at school may be highly cost-effective for tetanus prevention. This is especially true when immunizations are an incremental step in an integrated primary health care strategy that can, at the same time, include health education, administration of anthelmintics, screening and treatment for trachoma, and others (Steinglass, Brenzel, and Percy 1993).

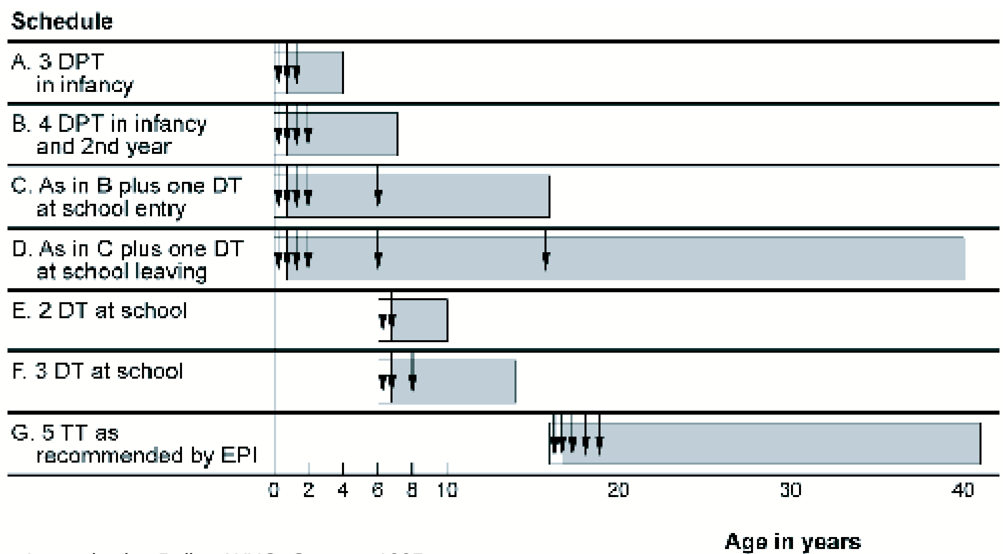
## Establishing Long-Term Goals

Nevertheless, it is obvious that the opportunity to immunize school children has been missed. For example, in the districts around Lake Victoria, which in the late 1980’s reported the highest incidence of NNT in Kenya, more than 95 percent of girls were enrolled in the first grade of primary school. The same districts had some of the lowest rates of TT coverage among pregnant women in the country. However, the youngest school children were not perceived as a potential target because, according to the senior immunization manager, “they would not be pregnant by the year 1995—the target date for NNT elimination.” Short-term goals distracted program managers from adopting technically sound medium-term strategies. Failure to establish a routine system for immunizing the youngest school children ten years ago and future cohorts since then, when they were easily located in school, has contributed to today’s problem in protecting them.

Referring to the expected duration of immunity after different immunization schedules (see figure 1), WHO’s policy is the following:

> All developing countries where women enter childbearing age without documentation of previous TT immunization in infancy or adolescence should adopt a five-dose TT program (schedule G).
>
> Developing countries should progressively adopt schedule B (four doses of DPT in infancy and second year) when they reach 80 percent coverage of the third dose of DPT in infants in all districts.
>
> Where possible, immunization of school children with TT or Td (schedules C–F) should be implemented.
>
> A reduction in the number of doses of TT given to women of childbearing age should only be made when a high level of immunity in adolescent girls can be documented by immunization records or results of serological studies (Global Program for Vaccines and Immunization 1995).

**Figure 1.**
*Expected Duration of Immunity after Different Immunization Schedules*




Source: Immunization Policy, WHO, Geneva, 1995.

## School Enrollment Data

A wealth of useful school enrollment data exists. The levels of enrollment in the early primary school are remarkably high, including enrollment in countries where NNT remains a serious problem and infant DPT coverage rates are not very high. The immunization program should take advantage of the high primary school enrollment rates.

The education sector uses two common indicators—

| | |
|---|---|
| **Gross enrollment ratio** | Total number of children enrolled in a schooling level—whether or not they belong in the relevant age group for that level—expressed as a percentage of the total number of children in the relevant age group for that level. |
| **Net enrollment ratio** | Total number of children enrolled in a schooling level who belong in the relevant age group, expressed as a percentage of the total number in that age group. |

It is important to know the availability and source of data. The data that are needed to make appropriate strategic decisions within each country come from routine service statistics, supplemented by surveys. At the national level, these data are available from the Ministry of Education, World Bank, UNESCO, and occasionally UNICEF. A useful secondary and widely available source of data is the UNICEF State of the World's Children report, 1997.

Some individual countries have a local USAID-funded education project, managed by World Education (Nepal, Mali, Cambodia, and others) or the Academy for Educational Development (Uganda and others), which may have useful data. In 27 African countries, a nongovernmental organization (NGO), FAWE (Forum of African Women Educationalists), funded by the Rockefeller Foundation, World Bank, and UNESCO, may also have useful data. The FAWE country office is usually located at one of the universities.

Table 4 summarizes the increases in male and female primary school enrollment ratios in the developing nations and the least developed nations from 1960 to the mid-1990's. The net enrollment ratio in developing and least developed countries in 1990–1995 is 81 percent and 45 percent, respectively. In primary schools, female enrollment as a percentage of male enrollment is 89 percent in all developing countries and 79 percent in the least developed countries. By 1990, of the 538 million children age 6-11 years in developing countries, 76 percent were in school, up from 48 percent in 1960 and 69 percent in 1980. However, global data can mask important regional and country differences.

**Table 4. Summary of Progress in Education**

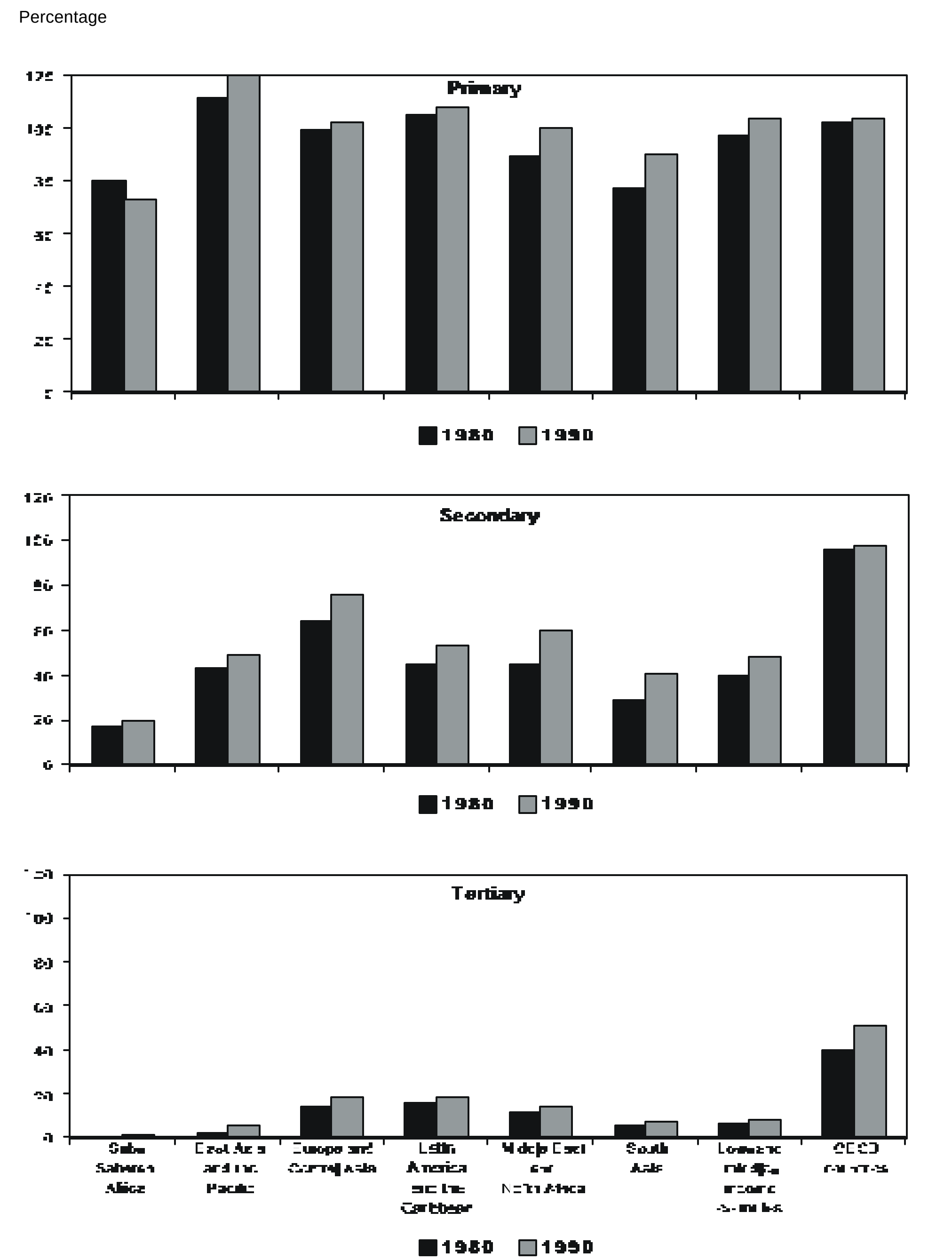
| Enrollment by Percentage | Developing Countries | Least Developed Countries[1] |
|---|---|---|
| Enrolled in primary school (%) | 98 | 66 |
| Primary school enrollment ratio (%) 1960 (gross), male | 93 | 47 |
| Primary school enrollment ratio (%) 1960 (gross), female | 62 | 23 |
| Primary school enrollment ratio (%) 1990–1994 (gross), male | 103 | 74 |
| Primary school enrollment ratio (%) 1990–1994 (gross), female | 92 | 59 |
| Primary school enrollment ratio (%) 1990–1995 (net), male | 86 | 56 |
| Primary school enrollment ratio (%) 1990–1995 (net), female | 81 | 45 |
| Primary school enrollment, females as percentage (%) of males | 89 | 79 |
| Secondary school enrollment, females as percentage (%) of | 81 | 59 |

[1] The least developed countries are a sub-set of developing countries including Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Laos, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sierra Leone, Somalia, Sudan, Tanzania, Togo, Uganda, Yemen, Zaire, and Zambia.

Source: Based on data presented: UNICEF 1997.

Figure 2 illustrates the gross enrollment ratios by region and level of education in 1980 and 1990. Except in sub-Saharan Africa, the primary school gross enrollment ratios increased and the ratios are at or above 90 percent. Secondary school ratios improved everywhere from 1980 to 1990; however, they are still much lower than the primary school ratios.

**Figure 2.**
*Gross Enrollment Ratios by Region and Level of Education, 1980 and 1990*

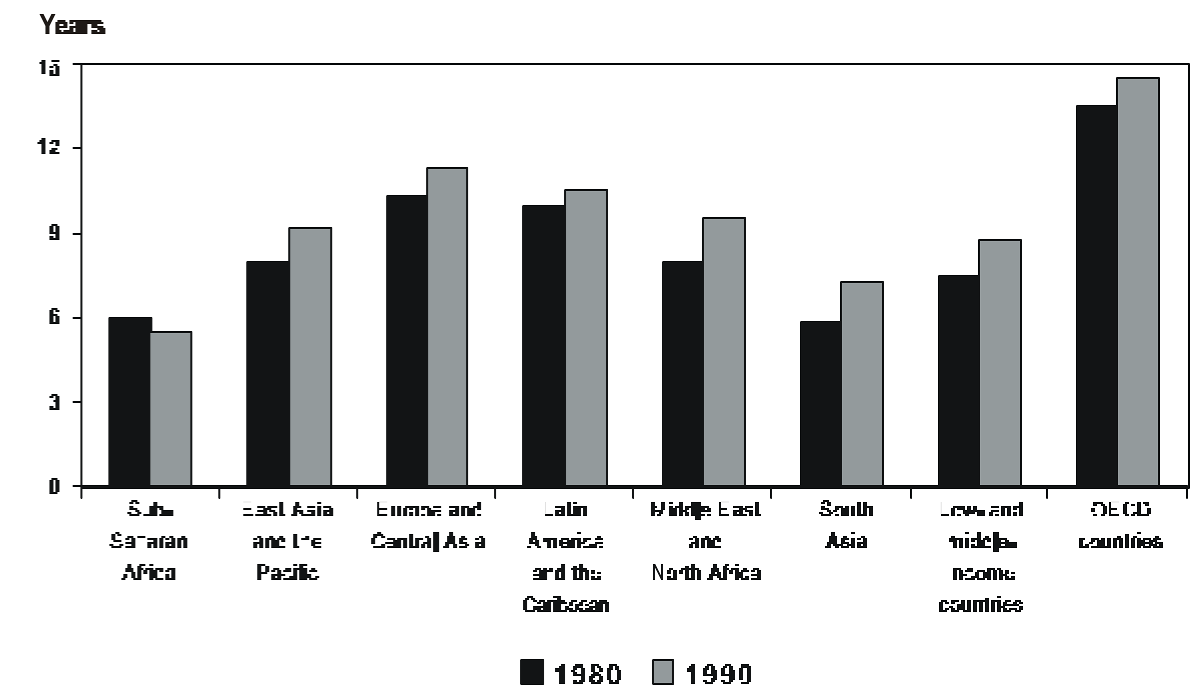



Note: The gross enrollment ratio is the ratio of total enrollment, regardless of age, in a given level of education to the population age group that corresponds to the official school age of this level of education in a given country.

Source: World Bank 1995.

Figure 3 depicts the expected years of schooling by region in 1980 and 1990. Only in sub-Saharan Africa did the number of years of schooling drop slightly. The average 6-year-old in one of the low- and middle-income countries in 1990 completed 8.5 years of school. The corresponding figure for sub-Saharan Africa is more than five years and for South Asia is more than seven years.

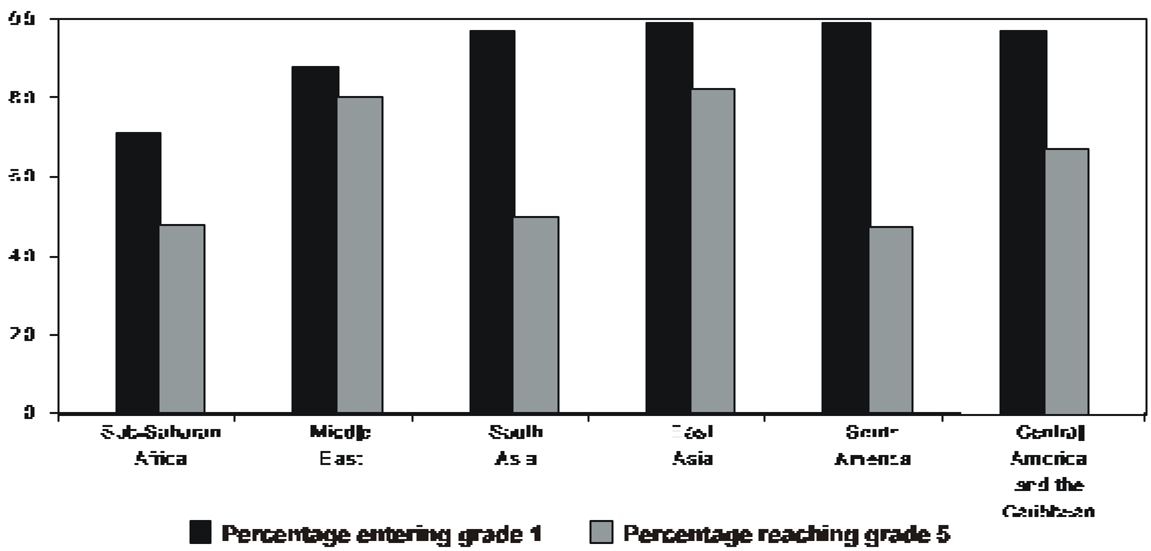
**Figure 3.**
*Expected Years of Schooling by Region, 1980 and 1990*




Source: World Bank 1995.

Figure 4 shows the primary school enrollment and retention by region in approximately 1990. Enrollment ratios in first grade are above 90 percent in all regions, except in sub-Saharan Africa, where they are about 70 percent. However, the proportion of children reaching grade 5 is roughly the same (between 40 and 50 percent) in sub-Saharan Africa, South Asia, and South America.

**Figure 4.**




*Primary School Enrollment and Retention by Region, about 1990*

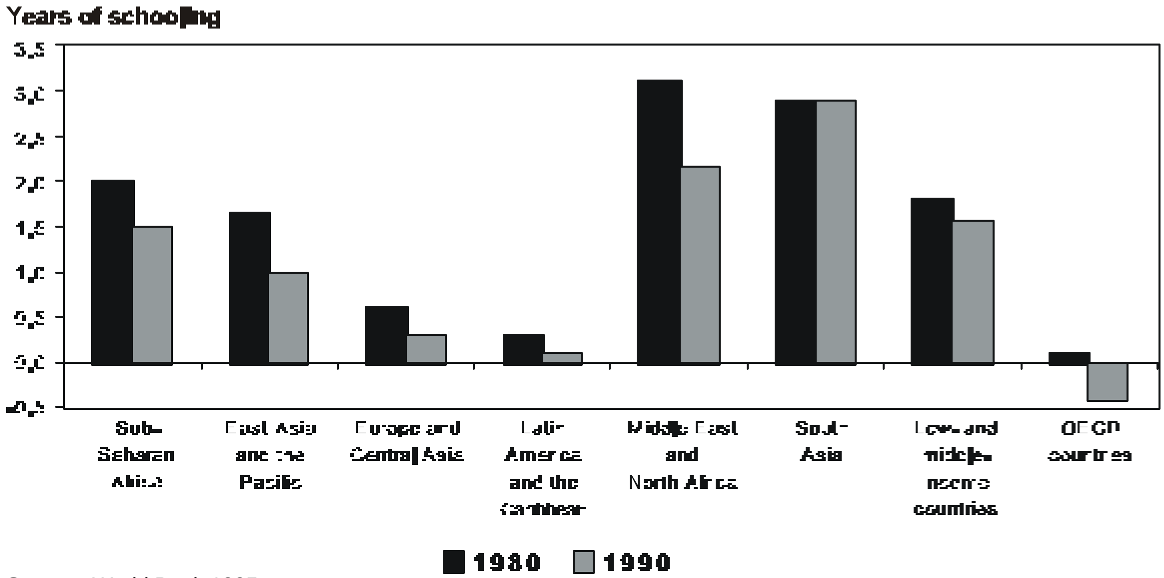
Percentage

Figure 5 shows the gender gaps in expected years of schooling by region in 1980 and 1990. South Asia has the widest gender gap; on average, girls go to school for 6 years and boys for 8.9 years. In the Middle East, the corresponding figures are 8.6 and 10.7 years. All regions have narrowed the gap in years of schooling, except South Asia, where it is unchanged. According to the FAWE, the same number of boys and girls are now enrolled in the first grade in Africa. By fourth grade, 50 percent of females have dropped out. The gap is wider at the secondary school level in Africa; attendance is 10 percent for girls and 36 percent for boys.

Note: Data do not include overage children and are projected using reconstructed cohort analysis. Regions are those used by UNICEF.

Source: World Bank 1995.

**Figure 5.**
*Gender Gaps in Expected Years of Schooling by Region, 1980 and 1990*




Source: World Bank 1995.

Table 5 shows the percentage of children ages 6–11 in school in 1990 and projected to be in school in 2000. Female enrollment ratios are expected to decline slightly in South Asia and sub-Saharan Africa. Nevertheless, 73 percent of girls (range is 45 to 88 percent by region) will be in school in 2000, an increase from 71 percent in 1990.

**Table 5. Percentage of Children Age 6–11 in School in 1990 and Projected for 2000**

| Country | 1990 Enrollment (%) | | 2000 Projected Enrollment (%) | |
|---|---|---|---|---|
| | Total | Female | Total | Female |
| All developing countries | 76 | 71 | 78 | 73 |
| Sub-Saharan Africa[1] | 50 | 46 | 49 | 45 |
| Middle East[1] | 76 | 69 | 79 | 73 |
| Latin America and the Caribbean | 87 | 87 | 89 | 88 |
| East Asia | 86 | 84 | 87 | 86 |
| South Asia | 73 | 72 | 77 | 68 |

[1] Four North African countries are included in both sub-Saharan Africa and the Middle East.

Source: Based on data presented: World Bank 1995.

The next three tables (tables 6, 7, and 8) provide important insights because regional averages conceal some crucial differences between countries.

Table 6 shows DPT3 coverage in 1992–1995 and the percentage of females enrolled, by level of education, in selected countries. In Nigeria, in 1994, the gross enrollment ratio for girls in primary school was 79 percent but the infant DPT3 coverage in 1992–1995 was only 27 percent. In Indonesia, the gross female enrollment ratio is 113 percent because many older children and possibly younger children also attend school. The net enrollment ratio at 95 percent in Indonesia is still high when the out-of-range children are excluded. This ratio is higher than the infant DPT3 coverage rate of 78 percent for 1992–1995. Most of the countries with the greatest NNT problem have female secondary school enrollment ratios well below 50 percent.

Table 7 shows the distribution of female enrollment by primary school grade in selected countries and the percentage of the 1992 cohort (both sexes) to reach grade 5. These data indirectly measure the drop-out rates between grades, over time. However, the data are influenced by past fluctuations in births and secular trends, such as the rapid development of education programs in some countries. It is appropriate to focus on enrollment ratios in the lowest grades of primary school; it can be assumed that children who drop out of school are more likely as adolescents and adults to deliver a baby with tetanus than children with more years of education. Some countries have a concentration of female primary school children in the first grade: 29 percent in Eritrea, 30 percent in Bangladesh, 36 percent in Cambodia, and 43 percent in Nepal. In countries with a mature educational system, there is an even distribution of female students across grades, for example, in Indonesia, Egypt, and Zambia.

**Table 6. DPT3 Coverage and Percentage of Females Enrolled by Level of Education in Selected Countries**

| WHO Region/ Country | DPT3[1] | Year | Primary Gross (%) | Primary Net (%) | Secondary Gross (%) | Secondary Net (%) |
|---|---|---|---|---|---|---|
| **African Region** | | | | | | |
| Angola | 21 | 1990 | 87 | — | — | — |
| Cameroon | 46 | 1994 | 84 | — | — | — |
| Eritrea | 45 | 1993 | 43 | 25 | 13 | 11 |
| Ethiopia | 51 | 1993 | 21 | 17 | 10 | — |
| Ghana | 55 | 1991 | 70 | — | 29 | — |
| Kenya | 84 | 1993 | 91 | — | 23 | — |
| Madagascar | 47 | 1993 | 72 | — | 14 | — |
| Malawi | 73 | 1994 | 114 | 93 | 4 | 2 |
| Mali | 46 | 1994 | 25 | — | — | — |
| Mozambique | 46 | 1995 | 54 | — | 6 | — |
| Nigeria | 27 | 1994 | 79 | — | 28 | — |
| Senegal | 80 | 1993 | 51 | — | — | — |
| Uganda | 79 | 1993 | 59 | — | — | — |
| Tanzania | 88 | 1993 | 69 | 51 | 5 | — |
| Zaire | 26 | 1993 | 58 | 47 | 15 | 11 |
| Zambia | 72 | 1994 | 79 | 68 | 19 | — |
| Zimbabwe | 80 | 1993 | 111 | — | 39 | — |
| **Eastern Mediterranean Region** | | | | | | |
| Afghanistan | 41 | 1995 | 32 | — | 11 | — |
| Egypt | 90 | 1994 | 91 | — | 71 | — |
| Iran | 97 | 1994 | 97 | — | 62 | — |
| Pakistan | 35 | 1993 | 42 | — | — | — |
| Yemen | 37 | 1993 | 47 | — | 9 | — |
| **European Region** | | | | | | |
| Turkey | 51 | 1993 | 94 | 87 | 50 | 46 |
| **South-East Asia Region** | | | | | | |
| Bangladesh | 69 | 1990 | 73 | 66 | 13 | 13 |
| India | 89 | 1993 | 91 | — | 38 | — |
| Indonesia | 78 | 1993 | 113 | 95 | 38 | — |
| Nepal | 63 | 1993 | 88 | — | 19 | 15 |
| Sri Lanka | 93 | 1994 | 104 | — | 79 | — |
| Thailand | 94 | 1992 | 97 | — | 37 | — |
| **Western Pacific Region** | | | | | | |
| Cambodia | 79 | 1994 | 106 | — | 18 | — |
| China | 92 | 1993 | 116 | 95 | 51 | — |
| Laos | 53 | 1993 | 92 | 61 | 41 | — |
| Papua New Guinea | 50 | 1995 | 75 | — | 11 | — |
| Philippines | 85 | 1993 | 111 | — | — | — |
| Viet Nam | 93 | 1985 | 100 | — | 41 | — |

[1] DPT3 coverage (%) in one-year-old children, 1992–1995.

Note: Dash (—) indicates that data were not obtained or not comparable.

Source for education data: UNESCO 1997.
Source for DPT3 data: UNICEF 1997.

**Table 7. Female Education at First Level: Distribution (%) of Enrollment by Grade**

| WHO Region/ Country | Grade in School (%) | | | | | | | Percentage of 1992 cohort (both sexes) to reach grade 5 |
|---|---|---|---|---|---|---|---|---|
| | I | 2 | 3 | 4 | 5 | 6 | 7 | |
| **African Region** | | | | | | | | |
| Eritrea | 29 | 22 | 20 | 18 | 11 | — | — | 79 |
| Ethiopia | 37 | 17 | 13 | 12 | 10 | 11 | — | 58 |
| Madagascar | 36 | 22 | 18 | 12 | 11 | — | — | 28 |
| Mali | 27 | 23 | 19 | 13 | 11 | 8 | — | 85 |
| Mozambique | 35 | 24 | 19 | 13 | 10 | — | — | 35 |
| Nigeria | 21 | 18 | 17 | 16 | 15 | 13 | — | 92 |
| Uganda | 25 | 18 | 17 | 14 | 11 | 9 | 6 | 55 |
| Zaire | 25 | 19 | 18 | 15 | 13 | 10 | — | 64 |
| Zambia | 17 | 16 | 16 | 15 | 13 | 12 | 12 | — |
| **Eastern Mediterranean Region** | | | | | | | | |
| Afghanistan | 18 | 17 | 17 | 16 | 16 | 16 | — | — |
| Egypt | 22 | 21 | 20 | 19 | 18 | — | — | 98 |
| Iran | 20 | 20 | 20 | 21 | 20 | — | — | 90 |
| Oman | 17 | 18 | 18 | 17 | 16 | 14 | — | 96 |
| Pakistan | 35 | 20 | 17 | 14 | 13 | — | — | — |
| **European Region** | | | | | | | | |
| Turkey | 21 | 20 | 20 | 20 | 19 | — | — | 89 |
| **South-East Asia Region** | | | | | | | | |
| Bangladesh | 30 | 23 | 20 | 15 | 13 | — | — | — |
| India | 28 | 22 | 19 | 17 | 14 | — | — | 62 |
| Indonesia | 19 | 18 | 18 | 16 | 15 | 14 | — | 92 |
| Nepal | 43 | 19 | 15 | 13 | 10 | — | — | 52 |
| Sri Lanka | 19 | 20 | 20 | 21 | 21 | — | — | 92 |
| Thailand | 17 | 17 | 17 | 17 | 16 | 16 | — | 88 |
| **Western Pacific Region** | | | | | | | | |
| Cambodia | 36 | 25 | 17 | 12 | 11 | — | — | 50 |
| China | 21 | 19 | 17 | 17 | 16 | 9 | — | 88 |
| Laos | 40 | 22 | 16 | 12 | 10 | — | — | 53 |
| Papua New Guinea | 23 | 20 | 17 | 15 | 13 | 11 | — | 71 |
| Philippines | 21 | 18 | 17 | 16 | 14 | 13 | — | — |
| Viet Nam | 28 | 22 | 19 | 16 | 14 | — | — | — |

Note: Dash (—) indicates that data were not obtained or not comparable.

Source: UNESCO 1997.

Table 8 shows female enrollment as a percentage of the male enrollment for 1990–1994 in selected countries. Countries as diverse as Kenya, China, and Indonesia report that nearly as many females go to primary school as males. Pakistan, however, reports that females enrolled as a percentage of males enrolled is only 51 percent in primary school.

## Analyzing the Data

A review of tables 6, 7, and 8 reveals a profile of individual countries. In some countries, school drop-out rates are high. In Madagascar, the gross female enrollment ratio is 72 percent and the net is 63 percent, but only 28 percent of primary school children (boys and girls) enter grade 5. Conversely, in Kenya the gross female enrollment is 91 percent in primary school, 77 percent of primary school children complete grade 5, and there is no difference in the ratio of female to male primary school enrollment.

The disparities are as interesting as the similarities. In Bangladesh, the gross female enrollment ratio is a high 73 percent; in nearby Pakistan, it is only 30 percent. Some countries (for example, Egypt, Iran, Sri Lanka, and China) have female secondary enrollment ratios of more than 50 percent. In these countries, a dose of Td could be added during secondary school, closer to the age when females have their first pregnancy.

Some countries, suffering from years of civil unrest (for example, Eritrea and Cambodia) may have a better developed primary education system than health system. In this case, “catch-up” DT could be given to the young girls and boys in school because most of them have missed their primary immunization series.

In districts considered at the highest risk for NNT, it is important to solicit data on a few indicators, such as female school enrollment by grade, because the national-level data conceal disparities by province and district, gender, and grade in school. Attachment A is an instrument to collect key data on immunization and school enrollment rates at the district level. Attachment B, when completed, can be used by national managers and their partner agencies to make country- and district-level decisions about where and when to add school-age booster immunizations to fight NNT.

Limited feedback from the field is included in this discussion paper. The WHO staff in China reports that primary school attendance is greater than 90 percent in rural China, and all counties designated as high-risk areas for NNT have high enrollment ratios. With China’s one-child policy, the staff wants to ensure that a family’s one birth is protected against NNT. China already has high routine DPT coverage rates; to provide lifelong protection, they are considering the introduction of TT4 and TT5 in primary schools (Alan Schnur, WHO/WPRO, personal communication, 4 April 1997). WHO staff reports that Indonesia uses DT1 in grade 1, DT2 in grade 2, TT1 in grade 3, and TT2 in grade 4. DT2 coverage is estimated at 60 percent (Dr. Francois Gasse, WHO/Geneva, personal communication, 12 March 1997).

**Table 8. Enrollment Ratios: Females as a Percentage of Males, 1990–1994**

| WHO Region/Country | Primary (%) | Secondary (%) |
|---|---|---|
| **African Region** | | |
| Angola | 92 | — |
| Cameroon | 85 | 72 |
| Eritrea | 79 | 76 |
| Ethiopia | 70 | 92 |
| Ghana | 84 | 64 |
| Kenya | 99 | 82 |
| Madagascar | 96 | 100 |
| Malawi | 92 | 50 |
| Mali | 63 | 50 |
| Mozambique | 74 | 67 |
| Nigeria | 78 | 84 |
| Senegal | 75 | 52 |
| Uganda | 80 | 57 |
| Tanzania | 97 | 83 |
| Zaire | 74 | 45 |
| Zambia[1] | 92 | 56 |
| Zimbabwe | 93 | 78 |
| **Eastern Mediterranean Region** | | |
| Afghanistan | 35 | 36 |
| Egypt | 85 | 85 |
| Iran | 93 | 78 |
| Oman | 94 | 89 |
| Pakistan | 53 | 46 |
| Yemen | 39 | 21 |
| **European Region** | | |
| Turkey | 92 | 65 |
| **South-East Asia Region** | | |
| Bangladesh | 87 | 52 |
| India | 81 | 64 |
| Indonesia | 97 | 81 |
| Nepal | 67 | 50 |
| Sri Lanka | 99 | 110 |
| Thailand | 99 | 97 |
| **Western Pacific Region** | | |
| China | 97 | 85 |
| Laos | 75 | 61 |
| Papua New Guinea | 84 | 67 |
| Philippines[1] | 99 | 102 |
| Viet Nam[1] | 94 | 93 |

[1] Data refer to years or periods other than those specified in the column heading, differ from the standard definition, or refer to only part of a country.

Note: Dash (—) indicates that data were not obtained or not comparable.

Source: UNICEF 1997.

# Practical Implications of Introducing Preschool and School-Age Booster Doses

## Introducing a Fourth Dose of DPT

There are many practical implications to consider before DPT4 is introduced into the immunization schedule. Hopefully, the information and suggestions in this chapter will stimulate discussion. This discussion paper is not the final word.

### Nomenclature

A global decision is needed about whether the fourth dose of DPT should be considered part of the primary series or a booster/reinforcing dose. Subtle differences may have important implications. Apparently, it was easier for UNICEF to justify the procurement of four doses of DPT in the Newly Independent States, instead of providing only three doses as in African countries, after WHO expanded the regional definition of a primary series to include a fourth dose. However, if the primary series is redefined on a regional basis to include DPT4, it may cause some countries within the region to lobby prematurely for its inclusion in their immunization schedules—before the countries' DPT4 coverage is uniformly and consistently high.

As a convention, it seems preferable to name the dose "DPT4," instead of "the DPT booster." Information about DPT4 should clearly state that this dose should not be given to children older than 5 years of age.

### Phasing in DPT4

The introduction of DPT4 may create dilemmas. The timing of DPT4 introduction may require absolute rules because they will simplify the process. The rules, however, may seem arbitrary. There are powerful arguments for waiting until coverage with DPT4 is uniformly high (e.g., more than 80 percent) in all districts, for several years, to ensure that the addition of DPT4 does not detract from the primary need to immunize the maximum number of children with three doses of DPT.

However, the need for protection and the risk from disease are not uniform within a country; they are influenced by the changing epidemiology that results from immunization programs. For example, rural underserved populations are at a greater risk from tetanus than urban residents. Rural communities could benefit from DPT4 even when coverage in urban areas remains below a threshold level. Conversely, urban residents may be at a greater risk from diphtheria than their rural neighbors.

Should we discard the option of using vaccines flexibly within countries, based on epidemiological considerations? If, for political reasons, DPT4 cannot be given until every district has uniformly high coverage, then we should determine why some districts are unable to achieve the required coverage. For example, protracted civil disturbance may preclude attainment or maintenance of sufficiently high coverage levels in one part of a country.

Despite rapid decentralization, the national level in nearly all countries is still responsible for setting standards regarding the immunization schedule. However, as districts become responsible for their budget, it may be difficult in some countries for national levels to mandate either the introduction of another dose or the requirement that one district must wait for the other districts before booster doses are introduced. One reason to introduce DPT4 at the national level instead of the district level is to avoid the inevitable confusion that arises when individuals or displaced populations travel from one district to another.

### Vaccine, Cold Chain, and Injection Safety

Of all the EPI vaccines, toxoids require the most volume for storage and transport. By adding a single booster dose in the second year of life, the quantity of vaccine and required storage space will, theoretically, increase a maximum of 33 percent compared with the vaccine and storage required for three DPT doses. In reality, less than 33 percent additional vaccine and storage will be required. In programs that discard opened vials of DPT at the end of the day, the addition of a DPT booster will probably reduce wastage. In programs that use opened vials of DPT vaccine on multiple days, a new booster dose will increase the vaccine and storage requirements. In some countries, it is possible that, when a cohort of children requires a booster, some costs can be offset if DPT is purchased in vials larger than the standard 10 or 20 doses.

When new vaccines are included (for example, hepatitis B) and larger quantities of existing vaccines are needed for mass campaigns (OPV, TT, measles), the storage capacity of the existing cold chain may need to be increased at the health facility, district, provincial, or central level. Every level will need to assess whether its existing vaccine storage capacity can handle this increase. If the capacity is insufficient, additional refrigerators or cold boxes will be required or the duration of storage at any given level must be shortened to accommodate the larger bulk. More frequent shipments of vaccine between the cold chain levels increase costs.

Because DPT4 will be given throughout the year according to routine schedules as children reach the designated age, no extraordinary logistical requirements are expected in terms of staff, injection equipment, or transport. The same injection technologies used for the primary series will be needed. If sterilizable syringes and steam sterilizers are used, more frequent replacement can be anticipated. Some high-volume health facilities or outreach sessions may require double-rack sterilizers instead of the present single-rack models.

### Monitoring

Including DPT4 will require revised tally sheets and reporting forms. Coverage should be routinely monitored. To calculate coverage, the numerator is the number of children 12–23 months of age who were immunized with DPT4 during a specific period. The denominator is the population of children 12–23 months of age, during the same period, calculated from the number of newborns minus the number of infant deaths. Vaccination cards should be altered to reflect the addition of DPT4.

Drop-out rates will also be monitored, as illustrated below for 1997:

$$\frac{\text{DPT1 in 1997} - \text{DPT4 in 1997}}{\text{DPT1 in 1997}} \times 100$$

### Screening

In targeted districts and countries, all children should receive DPT4. For optimal antibody response, the interval between DPT3 and DPT4, and between DPT4 and subsequent school-age DT or Td boosters, must be at least 12 months.

### Marketing/Information, Education, and Communication

There must be a clear message that DPT4 is a required dose. The introduction of a new vaccine may cause confusion for the public and the health workers, and arouse suspicion that the vaccine is not as strong as previously thought. Any public information to health workers, parents, and community leaders must stress the importance of continued timely immunization during the first year of life to ensure that parents or caretakers do not postpone the primary series.

## Boosters at School Age

Many practical implications of introducing booster doses at school age need to be considered. The following information is intended to stimulate discussion as a first step and is not meant to be the final word. National and local decisions would need to be made on many of the following points, well in advance of launching school-based immunization. A manual would be needed to guide managers on how to make the necessary locally appropriate decisions.

### Nomenclature

The booster dose given at school age and in subsequent grades could be either DT or Td. For reporting and monitoring purposes, it is simpler to consider them interchangeable. Therefore, the first dose of DT is called DT1 and the second dose of DT is called DT2. However, if a Td booster is given the following year, the booster is a continuation of the booster series and is recorded as Td3.

### Organizational Issues

To make school-based immunizations succeed, the MOH will need the cooperation of the Ministry of Education and the support of headmasters and teachers. In some countries, there is a school health division within the MOH but, frequently, it is not very active due to a lack of resources.

### Choice of Vaccine

Immunization programs should progressively use DT or Td in place of TT vaccine. Without periodic boosters, diphtheria immunity wanes. It is just a matter of time before diphtheria outbreaks, witnessed in the early 1980’s in North Yemen and the 1990’s in Sudan, Yemen, Algeria, Ecuador, Laos, Mongolia, Iraq, and Thailand, become common in developing countries.

Children 7 years old and under are eligible to receive their school-age boosters with DT. Compared with Td, DT will result in better priming in children not previously immunized. After the age of 7, Td is preferred. The rate of reactions must be monitored as infant immunization coverage continues to increase because DT is more reactogenic in previously immunized children. MOHs can determine when to phase out DT and replace it with Td for school-age children.

Older children or even adults may be found in the lower grades, especially in a recently built school or rapidly expanding educational system. Immunization teams must know if they should immunize the older children in early grades with Td instead of DT. However, DPT must not be given to children over the age of 5 because of the heightened risk of serious adverse reaction.

### Phasing in School-Age Booster Immunization

District-level data should be used to determine when and where to phase in school-age immunization. Ideally, widespread school-age vaccinations should begin within a country wherever there is a significant female school enrollment ratio. In practice, however, decisions must be made at the country level, based on the availability of financial and human resources and the presence of adequate cold chain and injection equipment. The decision to initiate immunization in a specific district depends on the level of female enrollment; however, both boys and girls should be targeted.

One of two rules can be used to determine if school-age boosters should be given—

1. When female primary school enrollment ratios in the district are higher than 50 percent, or

2. When female primary school enrollment ratios in the district exceed infant DPT4 coverage rates

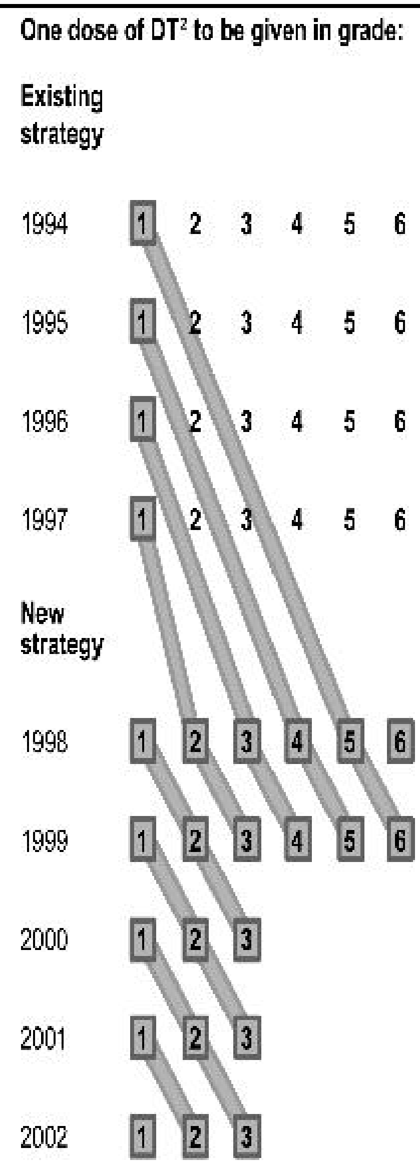
By following rule 1 and applying it to the national data available for the selected countries in table 6, the following countries would not initiate school-based immunization: Eritrea, Ethiopia, Mali, Afghanistan, Pakistan, and Yemen.

However, using the more appropriate district-level data, some districts within these countries would probably qualify for the introduction of school-age boosters. By following rule 2, Pakistan and Yemen would qualify and be reaccepted for school-age boosters. Again, to make the final decision, data at the district rather than the national level should be applied.

If rule 1 was adjusted from a threshold level of 50 percent to a level of 70 percent, additional countries from table 6, including Mozambique, Senegal, Uganda, Tanzania, and Zaire (Democratic Republic of the Congo), would not qualify, based on national data for the introduction of school-age boosters. However, Mozambique and Zaire would qualify and be reaccepted for school-based boosters if rule 2 was used. It is advisable for each country to use district data to make the decision.

A country with high female enrollment levels in all primary grades presents a special case if the country plans to change an existing school-age policy. Figure 6 includes a grid for senior policy makers to illustrate one possible option in 1998—to change from an existing one-dose DT schedule in grade 1 to a new schedule. First, a catch-up immunization program for the six primary grades is introduced in 1998 and 1999, and a maintenance schedule that includes one dose of DT/Td in each of the first three primary grades is introduced in 2000. In the example, the country takes advantage of the high primary school enrollment and low drop-out rate to boost the immunity of children in all grades because they had received only one dose of DT when they were in grade 1. Using the current schedule, children who received one dose of DT in 1994, in grade 1, are reimmunized under the proposed new schedule with one dose of Td in grade 5 in 1998 and one dose of Td in grade 6 in 1999. This schedule ensures that the children who are already enrolled receive three doses, which corresponds to the proposed new three-dose schedule for children that enter grade 1 in 1998.

**Figure 6.**
*Example of Accelerated Strategy*[1]




1 Accelerated strategy for giving DT/Td to school children when an existing school-based immunization schedule is revised.

## Immunization Schedules

School-age strategies must be designed with the population, not individuals, in mind. The optimal schedule and delivery strategy must be simple to understand and implement. Unimmunized children should be primed, and immunized children should have their protection extended. It is difficult—or sometimes impossible—to know the immunization history of an individual school-age child. However, if it was certain that an individual child had never been immunized, that child could be primed with two doses of DT at school entry, with four weeks between doses; a third dose could be given in the next grade, after one year, and a fourth dose in the next grade.

In districts that qualify to introduce school-age booster doses, managers must decide how many doses to offer and in what grade. This decision should be made by studying the relevant school enrollment ratios. The decision is complicated if historical DPT4 coverage data and the drop-out rate of cohorts from grade to grade are considered.

The goal is to immunize school children with boosters in the earliest grades before they begin to drop out. A total of three doses spaced at one-year intervals would be offered; this gives full protection to children previously immunized with three or more doses in infancy. For children previously immunized with one or two doses, the three school-age booster doses will protect them for at least another 10 years. For children not previously immunized, the third booster will provide a minimum of five years of protection. Of course, it is unlikely that the child's previous immunization status will be known. If a card is available, the child should be immunized based on a matrix that considers the previous number of doses.

With many countries likely to introduce DPT4 in the second year of life, offering a total of only three school-age boosters is a reasonable compromise. The simplest guidelines are—

*Option 1*
- DT1 in grade 1
- DT2 in grade 2 (given at least 12 months after DT1)
- Td3 in grade 3 (given at least 12 months after DT2)

The following option (option 2), which is a variation of option 1, is justified by high enrollment in later grades, a situation often found in mature and stable educational systems.

*Option 2*
- DT1 in grade 1
- DT2 in grade 2 (given at least 12 months after DT1)
- Td3 in the highest primary or secondary grade when the absolute number of female students exceeds 80 percent of the number of female students in grade 2 (given at least 12 months after DT2)

By monitoring coverage achieved by dose, a decision can be made about altering the immunization schedule for adults. After today's school-age population is adequately vaccinated and they become adults, it is expected that a reduced adult immunization schedule will be introduced. For example, a single dose of Td could be offered to women only during their first pregnancy. Population-based serological studies will be required. One advantage of implementing a school-age immunization strategy now is the reduction of the adult immunization schedule in the future.

## Vaccine, Cold Chain, and Injection Safety

Many of the same issues raised for DPT4 apply to school-age booster doses. However, school-age boosters will initially require a greater volume of vaccine to be stored and transported if, in the first year, the program uses catch-up strategies that target multiple grades. After the catch-up, the additional volume would still be greater than the volume with DPT4. For example, according to the maintenance strategies that most schools will probably adopt, although the eligible cohort of 6-year-olds would be similar in size to 1-year-olds who need DPT4, more than one cohort at school would receive its annual single booster dose. Larger vial sizes than the present size could be used, lowering costs and storage volumes per dose. For example, vaccine is available in 50- or 100-dose vials.

Unlike polio National Immunization Days (NIDs), there would be no epidemiological requirement for all children to be immunized at the same time, so it would be unnecessary to store all the required vaccine at the same time in the existing refrigerators. Otherwise, the storage capacity at all levels would be overwhelmed. Nevertheless, additional refrigerators and cold boxes would probably be required for such a large annual undertaking.

Logistically, the most efficient way to vaccinate school-age children might be district by district, using a rolling campaign. This approach would ensure that the demands on vaccine, injection equipment, staff, and transport were well managed and controlled. Injections could be given more safely. Sterilizable syringes and steam sterilizers, the preferred equipment, must be provided and replaced in adequate numbers. When a large number of vaccinations are given at the same time in a school, accidental freezing of toxoids or improper injection technique may result in a clustering of abscesses. To ensure that corrective action is taken, reports of abscesses should be monitored.

With the increased volume of DT and Td that must be refrigerated, refrigerators may be overfilled, increasing the possibility of vaccines freezing when the vials come in contact with the evaporator at the back of the refrigerator. To help guard against accidental freezing, STOPWATCH indicators should be used and regularly monitored in any refrigerator used to store the toxoids. Under strict guidance and supervision, DT and Td could be removed from the cold chain for a short time, if used quickly.

## Monitoring

Every booster dose should be included on revised tally sheets and reporting forms. To measure performance, coverage should be routinely monitored. To calculate coverage, the numerator in the equations below is the number of children, by grade, who were immunized with the respective booster dose in a given year. The denominator is the number of registered school children in that grade, in a given year. Forms could include sex-specific tallies to permit calculation of sex-specific coverage, although this may not be needed unless resistance is anticipated.

To stimulate competition between schools, immunization coverage should be reported and tracked for each school. Reporting by school, as well as by district, will discourage avid health workers from over-immunizing the same schools to achieve district targets.

School drop-out rates can be calculated in several ways if reports are kept on the actual number of children immunized, as illustrated for 1998 in the following equation:

$$\frac{\text{DPT3 in 1998} - \text{DT1 in 1998}}{\text{DPT3 in 1998}} \times 100$$

Analysis can include a comparison of doses received by the same cohort, over time, as illustrated in the equations below, for 1998, 1999, and 2000:

$$\frac{\text{DT1 in 1998} - \text{DT2 in 1999}}{\text{DT1 in 1998}} \times 100$$

$$\frac{\text{DT1 in 1998} - \text{Td3 in 2000}}{\text{DT1 in 1998}} \times 100$$

## Serological Testing

Serological testing is not needed to determine when to introduce DT in the early grades of primary school. Instead, the level of female primary school enrollment should be used to determine the appropriate time to introduce school-age boosters.

To answer specific questions about how successful the population-based immunization strategies have been in assuring protective levels of immunity, it would be necessary to schedule periodic serological testing of the population for tetanus and diphtheria at the age of puberty. The results would guide the modification of adult immunization schedules, target groups, and delivery strategies.

### Screening

Younger school-age children should receive DT regardless of their immunization history. However, it is possible, depending on previous doses received, that some older school children may not require additional doses during mass rounds. The only way to confirm a child's immunization history is to give each child, at the first school visit, a tetanus-diphtheria protection card that is durable enough to last into adulthood. Good medical records will help health workers assess the need for future doses of toxoids and will prevent overimmunization.

Completing a card for each child during the school visit is a major administrative burden. The dates of past toxoid immunizations in infancy and early childhood, if known, should be recorded on the card. Based on the card, health workers can determine if the child should receive boosters during subsequent mass rounds in higher grades or later as an adult. When the school and community are told about the campaign, parents should be instructed to send the child's immunization card to school either before or on the day of the actual campaign. Decision makers should consider adding a space on the infant immunization cards to record booster immunizations given at school age.

### Timing of School Visits

Ideally, successive school visits should be spaced at least 12 months apart but no more than 18 months. The longer the interval between doses, the better the final antibody levels. However, the interval should not be so long that children are missed because they have already dropped out of school. Intervals that are shorter than 12 months must be discouraged; successive boosters cannot be counted as valid unless there is an interval of at least 12 months between doses.

Mass campaigns should be avoided during the winter, particularly if freezing temperatures are expected. because of the volume of toxoid that must be stored and transported by lower levels of the health system where the cold chain conditions are weakest.

### Procurement

In developing countries that can receive vaccines through UNICEF procurement services, UNICEF can procure DT, also known as pediatric-type diphtheria-tetanus toxoid, more easily than Td vaccine, sometimes known as adult-type diphtheria-tetanus toxoid. Justification is needed as to why a children's agency like UNICEF is procuring adult-type vaccine. WHO needs to have an agreement with UNICEF about the procurement of tetanus-diphtheria booster doses as part of the Expanded Program on Immunization (EPI); otherwise, UNICEF may not be willing to procure the vaccine.

### Combined and Multi-Antigen Interventions

The school health team visit could be combined with other interventions. Health education could be provided to explain the importance of timely immunizations for infants as well as to provide information about any number of locally relevant topics. If appropriate, screening and treatment for trachoma could be offered. Anthelmintics and treatment of lymphatic filariasis could be dispensed. Countries that have eliminated polio, after many rounds of NIDs, may not be able to sustain political interest in other NIDs. In those countries, a new contact at school entry could provide an extra routine dose of OPV, increasing circulation of the vaccine virus in the community. Countries trying to improve measles control could use the same contact to give a routine second dose of measles vaccine. In the African meningitis belt, group A meningococcal meningitis immunization could be given. In areas with high typhoid mortality or with multiple antibiotic resistance, typhoid immunization could be given. If teachers and school children are to be told about the signs of NNT and provided with instructions about how and whom to notify about suspected cases, care must be taken to avoid rumors associating the toxoid injections with fertility control (see Marketing section).

The decision to combine school-based toxoid administration with other major immunization events for the same age group, such as mass measles or polio immunization within schools, should be made country by country. To avoid a serious missed opportunity, especially in areas at high risk for NNT, it makes sense to piggyback DT and Td immunization onto any planned school-based mass measles or group A meningococcal meningitis immunization campaign. Logistically, there are advantages and disadvantages to be considered when multiple antigens are given at the same time. When more than one injection is given on the day of the school visit, if the site for each antigen is standardized, such as the left arm for toxoids and right arm for measles vaccine, the antigen can be quickly identified if there is a serious side effect.

### Marketing

When booster doses are introduced, the public may be confused. Parents and health workers may question why another dose is suddenly required when the dose was not required in the past. To retain public confidence, civic leaders and religious authorities should be included when school-based campaigns are planned. They can help reassure the public when minor side effects, which are normal, occur after toxoid administration.

Eligibility for school-age vaccinations should include both girls and boys. If only females are targeted, it could cause damaging rumors that the booster doses are connected to fertility control. Toxoid administration could be marketed as protection against tetanus from injuries during sports, planting, and other activities. Discussing the protection of future births against NNT could contribute to the mistaken idea that the injections are related to fertility reduction.

There should be a clear plan to obtain consent to immunize school children. The community or individual parents should be notified, in culturally appropriate ways (verbally or in writing), that (1) the immunization team plans to be at the school on a specified day(s), (2) the presence of the child in school that day is construed as parental consent, (3) the vaccination is important and needed, and (4) minor side effects are normal. If a child is absent the day of the visit, the teacher could give the child an appointment slip to receive the vaccine at the nearest health facility. If there were enough absent children, the vaccination team could make a second prepublicized “mop-up” visit to the school. The importance of the boosters should be emphasized beyond school and into the community, as all children may not be enrolled in school.

It may be desirable to call the injections “school-age boosters.” The term “school booster” should be avoided; children can receive the boosters even if they do not attend school. Avoid the term “school entry" to ensure that the primary series is not postponed until the child is older, when the parent might incorrectly assume that, because the child is bigger, he or she can tolerate the injection better.

All children are eligible for school-age boosters whether or not they attend school; therefore, social mobilization methods and the cooperation of headmasters will be needed to mobilize the community. Schools may be the best venue to deliver immunizations to all age-eligible children.

# Conclusions

To reflect changing opportunities and local circumstances, countries trying to control NNT should periodically review their choice of immunization schedules, target groups, and immunization delivery strategies. Now that the 1995 target year for achieving global elimination of NNT as a significant public health problem has come and gone, it is time to plan for long-term NNT control—the elimination of NNT must be sustained forever. To maintain the momentum that started with the immunization of childbearing-age women in high-risk areas, and to take advantage of gains made in infant immunization, the adoption of other population-based approaches should be considered as a supplementary control strategy. In many settings, at the national and district levels, introducing booster doses with preparations containing tetanus toxoid in early childhood and at school age is now indicated as a long-term strategy for NNT control.

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Complete a separate form for each district that is considered at high risk for neonatal tetanus (NNT).

**~~Name of District:~~** ____________________

**Print Your Name:** ____________________

**A. Immunization Coverage**

| | 1992 | 1994 | 1997 |
|---|---|---|---|
| Infant DPT3 coverage (%) | | | |
| DPT4 coverage (%), if applicable | | | |

**B. Primary School Enrollment** **Year of Data:** __________

*Complete if these data are available.*

| | | Absolute number of school children | | Est. population of this age group | | School enrollment ratios: Net (%) | | School enrollment ratios: Gross (%) | |
|---|---|---|---|---|---|---|---|---|---|
| Grade | Typical age | Female | Male | Female | Male | Female | Male | Female | Male |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |

**C. Secondary School Enrollment** **Year of Data:** __________

*Complete if these data are available.*

| | | Absolute number of school children | | Est. population of this age group | | School enrollment ratios: Net (%) | | School enrollment ratios: Gross (%) | |
|---|---|---|---|---|---|---|---|---|---|
| Grade | Typical Age | Female | Male | Female | Male | Female | Male | Female | Male |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | | |

**D. Primary School Starters**

Estimate the percentage of female primary school starters that will reach grade 5. ______________________

## Attachment B: Develop Data-Based District-Level Strategies for Tetanus Boosters in Schools

**Complete the following activities:**

1. Identify the districts (or administrative units within the district) classified as having the highest risk for neonatal tetanus (NNT). For example, countries use TT2 coverage data, clean delivery data, NNT incidence rates, and, occasionally, "gut feelings" to identify districts where NNT cases cluster.
2. Visit the Ministry of Education (or World Bank, UNESCO, UNICEF, and others) for additional help in completing Attachment A for high-risk districts and, time permitting, for other districts. If a large number of districts are considered to be at high risk for NNT, select the three districts with the highest ratios of female primary school enrollment and select one district with a lower ratio.
3. Answer the following questions (use additional pages, if needed) after you complete Attachment A. You may modify Attachment A to fit the situation in your country. We are interested in the actual data you collect and your experiences as you try to obtain these data.

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**Name of Country:** ______________________________

1. List the districts with the highest risk for NNT. Attach a separate page, if needed.

______________________________

______________________________

______________________________

2. From the names of highest risk districts, select and list the three districts with the highest primary school enrollment ratios for females.

a. ______________________________

b. ______________________________

c. ______________________________

3. From the names of highest risk districts, select and list the one district with the lowest school enrollment ratio for females.

______________________________

4. Answer the following questions about immunizations:

4.1 In your country, what is the national policy regarding vaccination of school children with any "EPI vaccine"? Attach the immunization schedule, if desired.

______________________________

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## Attachment B (continued)

4.2 List each vaccine that is targeted in the schools and the grade when it is given. For an example, see below. Include all vaccines, not just tetanus toxoid.

*Example:* DT Grade 1

4.3 Does the school policy on vaccines vary by district?

4.4 How successful is the implementation of school policy on vaccines? Attach data, if available.

4.5 What immunization coverage rates in school have been achieved by grade, vaccine, and dose? Attach data, if available.

5. After you complete Attachment A for each district listed in questions 2 and 3 above, answer the following questions:

5.1 Explain how easy or difficult it was to obtain the district-level school enrollment data in the capital of your country. Indicate how long it took to collect these data.

5.2 List or identify the ease or difficulty of obtaining each of the enrollment figures.

Easy to obtain:

Hard to obtain:

5.3 List the national office(s) where the district enrollment data were obtained.

5.4 Do you think that these district school enrollment data are also available within the respective districts?

5.5 List the enrollment data that are available from routine service statistics and from special surveys.

Routine: ______

Special: ______

6. What is the average or median age of first pregnancy in your country or the proportion of births that occur before the mother is 15 years old? Identify the source and year of the data, and describe your data.

______

______

7. List any related enrollment indicators or other important data or information.

______

______

8. Do you doubt the accuracy of the reported data? Please explain.

______

______

9. List any ideas about how to improve the attached data collection form (Attachment A), based on the type of data available in your country. The form will be used to develop an appropriate school-based tetanus toxoid strategy.

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10. Provide any comments or concerns about practical ways to implement a school-based immunization program directed at females. For example, do you think that school boys need to be immunized at the same time that school girls are immunized?

______

______

**Print the following information:**

Your name: ______ Title: ______

Phone number: ______ FAX number: ______

E-mail address: ______

Send your completed forms to international partners, such as WHO and UNICEF, and to the author of this discussion paper.

Thank you for your help.